ISSN 0317-2473

Research Discussion Paper No. 85

Population Projection by Single Years of Age on a Personal Computer

by

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This project was partially supported by the Edmonton Metropolitan Regional Planning Commission.

NOVEMBER 1991

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Introduction

Population projection has a long history and it is more in demand than any other application of demographic principles and knowledge. Forecasting of population is now a part and parcel of administrations at all levels of government. The advent of computer technology and its widespread availability for data manipulation are the main factors that have helped to increase the use of population forecasting by a large number of agencies. (Bogue, 1974; Committee on Population and Demography, 1981)

The desktop computers of today are as powerful and fast as the mainframe computers of 1970's and so it is possible now to make population projection on a personal computer (PC). The programmes from mainframe computers have been ported to the PC (Pinal, 1985). Others have written programmes specific to PC for demographic analysis. (Levine, 1986; Field, 1987; Wells, 1990). Most of these programmes handle only five year age groups and consequently the population is projected at the interval five years. Even when single year age distributions are calculated in these programmes, they are generated by simple mathematical interpolation. The computer programme developed here starts with a population distribution by single years of age and calculations are made to project the population at an interval of one year. This programme (PROJS) will run on any IBM compatible PC.

Options Available in the Programme

This programme has a number of options which make it very versatile. All components of population change (mortality, fertility, and migration) can be altered in any year. In the output the projected population may be grouped into any special age groups as required. The options are listed below.

1. Change in mortality level is introduced by giving a new set of survival rates.
2. Migration (in and out migration) level can be altered in any year.
3. Fertility level is changed by specifying a new value for the total fertility rate (TFR). TFR is defined as the sum of the age-specific birth rates over all ages of the child bearing period. If the age specific rates are calculated for five-year age groups, as is the usual case, TFR is calculated by summing the rate and multiplying the sum by 5. It may be viewed as representing the completed fertility (or the total number of children born) of a synthetic cohort of women.
4. Custom made age groups can be specified. The output always includes standard five-

year age groups, the median age other demographic summary measures. It will also produce the population distribution for any number of (up to a maximum of 10) user specified age groups. Since the printing of single year age distribution by sex may take a lot of time, it may be excluded from the output, if user does not require it.

Preparation of Input Data file

This projection programme requires a data file in which the base data (age distribution by sex, survival rates, etc.) are stored as standard ASCII characters without any hidden or explicit formatting characters. Most of the line editors (e.g. IBM Personal Editor, DOS EDLIN, etc.) save a file in this manner. If a word processor such as Microsoft Word or Word Perfect is used to prepare the input data file, care should be taken to save the data as "text only with line breaks".

The numbers are entered with at least one space separating them. There should not be any commas or quotes to separate the numbers. All data should be placed between columns 1 and 80 of each line. There is no limit on the number of values that can be entered in one line; it can be as few as one value or as many as can be accommodated in a line between columns 1 to 80. Twenty one items are required in the input data file. They are listed below and should be entered in the same sequential order. Each item should start on a new line.

1. Name of the area
2. Base year for which data is available
3. The oldest age group (which is an open interval) for which data is provided. If it is given as 85, the programme expects data for ages 0, 1, 2, ... 84, and 85+.
4. A descriptive line (ID line) identifying the age distribution of males in the base year.
5. Single year age distribution of males in the base year
6. A descriptive line identifying age distribution of females in the base year.
7. Single year age distribution of females in the base year
8. ID line for the age distribution of male in-migrants.
9. Typical age distribution of male in-migrants
10. ID line for the age distribution of female in-migrants.
11. Typical age distribution of female in-migrants
12. ID line for the age distribution of male out-migrants.
13. Typical age distribution of male out-migrants
14. ID line for the age distribution of female out-migrants.
15. Typical age distribution of female out-migrants.
16. ID line for age specific fertility rates.

17. Age specific fertility rates (expressed as rate per person) for ages 12 to 49. Thirty-eight values (some of them can be zeros) are expected here.

18. ID line for male survival rates.

19. Survival rates for males.

20. ID line for female survival rates.

21. Survival rates for females.

If changes in mortality are to be done after projecting the population for a few years, additional sets of survival rates (similar to items 18 to 21) should be entered at the end of the file (i.e., after item 21).

An Example of an Input Data File

The following is the printout of an input file which can be used with the programme PROJS. This is stored in the file EDM1.DAT. Notice that there is only one set of survival rates and hence the mortality cannot be changed during the course of projection if this data file is used without any modification.

```
Edmonton
1990
90
Age distribution of males
4805 4804 4744 4774 4487 4549 4394 4164 3960 3861 3578 3449 3549
3406 3195 3245 3369 3476 4253 4723 5175 5322 5439 5734 6408 6558
6653 6554 6807 6928 6736 6400 6117 6005 5965 5353 5039 4740 4412
4673 4222 4032 3912 3251 3238 3094 2914 2707 2758 2794 2717 2500
2480 2551 2488 2442 2397 2424 2540 2552 2313 2215 2037 1994 1987
1858 1789 1711 1612 1511 1228 1132 1083 1046 1031  966  804  673
 674  659  599  498  420  389  382  317  245  204  178  124  460
Age distribution of females
4628 4560 4523 4419 4411 4258 4102 3845 3777 3600 3470 3313 3482
3309 3185 3159 3295 3288 4491 5228 5541 5872 5854 6026 6672 6806
6800 6562 6929 6724 6527 6209 5858 5790 5657 5277 4861 4391 4389
4296 4131 4000 3748 3399 3255 3047 3065 2897 2852 2834 2708 2629
2514 2559 2532 2492 2490 2381 2548 2438 2516 2273 2303 2284 2211
2187 2071 2173 2002 1859 1638 1530 1436 1421 1423 1324 1202 1125
1114 1019  909  813  714  709  630  550  477  404  372  258 1067
Age distribution of in-migrants: Males
44 67 81 93 89 107 98 87 84 109 110 115 116 117 118 119 125
135 141 153 298 300 320 340 320 291 275 235 156 168 160 145 44
122 49 87 45 70 45 63 42 28 34 56 14 27 22 21 18 14 19 16 15
15 15 7 6 7 3 5 3 4 4 3 2 4 4 4 4 3 2 2 1 1 1 1 1 2 1 1 1 1 1
1 1 1 1 1 1 1 1
Age distribution of in-migrants: Females
39 62 76 83 79 96 91 82 74 74 64 62 60 52 51 94 53 73 141 154
246 258 257 243 256 186 157 145 97 103 56 98 76 54 66 52 46 42
33 32 31 38 35 20 9 19 16 15 14 12 16 15 14 13 14 9 10 6 6 7 8
7 7 7 8 8 8 7 6 4 4 2 1 1 1 1 1 1 2 3 4 5 6 5 4 2 1 1 1 1 1
Age distribution of out-migrants: Males
```

```
121 124 123 128 132 152 131 121 101 77 77 65 63 57 53 119 73
83 141 153 298 275 287 278 253 300 310 290 260 250 200 180 180
160 150 140 120 70 45 63 42 28 34 56 14 27 22 21 18 14 19 16
15 15 15 7 6 7 3 5 3 4 4 3 2 4 4 4 4 3 2 2 1 1 1 1 1 2 1 1 1 1
1 1 1 1 1 1 1 1 1
Age distribution of out-migrants: Females
121 156 166 187 142 176 170 143 121 74 64 62 60 52 51 94 53 73
141 154 246 258 257 243 256 186 157 145 97 103 150 178 186 154
174 143 165 178 145 132 31 38 35 20 9 19 16 15 14 12 16 15 14
13 14 9 10 6 6 7 8 7 7 7 8 8 8 7 6 4 4 2 1 1 1 1 1 1-2 3 4 5 6
5 4 2 1 1 1 1 1
Age specific fertility rates for ages 12 - 49
.0005 .0063 .0101 .0122 .0134 .0142 .0199 .0258 .0354 .0390
.0422 .0483 .0514 .0631 .0781 .0867 .0913 .0912 .0907 .0884
.0875 .0867 .0854 .0845 .0832 .0821 .0819 .0811 .0701 .0612
.0563 .0434 .0395 .0313 .0211 .0109 .0032 .0011
Survival rates for males
.94540 .99911 .99970 .99960 .99909 .99971 .99941 .99970 .99970
.99971 .99993 .99980 .99960 .99965 .99950 .99970 .99885 .99870
.99831 .99805 .99860 .99864 .99850 .99846 .99870 .99853 .99913
.99860 .99895 .99850 .99870 .99924 .99812 .99840 .99833 .99881
.99820 .99842 .99727 .99742 .99841 .99752 .99750 .99644 .99680
.99713 .99522 .99475 .99477 .99507 .99350 .99350 .99152 .99244
.99000 .98930 .98770 .98850 .98606 .9856 .9854 .9825 .9820
.9818 .9813 .9801 .9760 .9774 .9764 .9761 .9760 .9731 .9719
.9698 .9678 .9654 .9653 .9651 .9650 .9647 .9643 .9641 .9621
.9612 .9601 .9592 .8991 .8883 .8881 .8621 .8432
Survival rates for females
.95562 .99922 .99953 .99960 .99960 .99962 .99980 .99992 .99970
.99968 .99999 .99980 .99999 .99993 .99980 .99970 .99923 .99964
.99930 .99954 .99960 .99970 .99961 .99963 .99920 .99933 .99940
.99958 .99960 .99930 .99920 .99931 .99960 .99990 .99907 .99870
.99890 .99861 .99821 .99904 .99909 .99800 .99765 .99752 .99750
.99780 .99740 .99733 .99740 .99720 .99701 .99680 .99660 .99640
.99591 .99585 .99506 .99484 .99290 .99118 .9886 .9865 .9854
.9833 .9822 .9810 .9791 .9782 .9772 .9761 .9760 .9753 .9751
.9743 .9692 .9682 .9679 .9688 .9691 .9697 .9696 .9686 .9667
.9675 .9648 .9592 .8999 .8889 .8889 .8629 .8438
```

Running the programme

The input data file EDM2.DAT will be used to illustrate the steps involved in applying the projection programme PROJS. The following paragraphs show the screen images of a typical run of the programme PROJS. The screen images are shown in boxes and the entries made by the user are shown in italics.

```
Type              1 if you want the programme to show
  you what it is reading
  0  otherwise
1
```

Entering 1 as the option will enable the user to see each stage of reading the input data from the file. This will be useful to isolate any error in the data.

```
Write the name of the data file where the
data base for the projection is stored.
  e. g. A:\PROJ\EDM.DAT
edmm.dat
```

The name of the data file is given as "EDMM.DAT". There is no file by that name in the current directory and so the following message is given.

```
*** Cannot find file  edmm.dat***
Write the name of the data file where the
data base for the projection is stored.
  e. g.. A:\PROJ\EDM.DAT
edm2.dat
```

Here the correct name of the file (EDM2.DAT) has been entered. Now the user is asked to give a name of a file where the results can be saved. It should be noted that if the given file already exists it will be over-written and its original content will be lost. If the file doesn't exist in the current directory it will be created. By giving the proper drive name and path (following the DOS conventions) the results can be stored any where. If you wish to have the results printed directly on a printer connected to the computer, the response should be PRN.

```
Write the name of the file where output
is to be saved.
  e. g. C:\WORD\POP.DOC
  or  PRN if a printer is connected.
out2.doc
```

The results will be stored in the file OUT2.DOC in the current directory.

```
Do you want the age distribution by single
years to be included in the output?

  Type  1 if it is to be included
  0 if it is to be excluded

1
```

If the single year age distribution is not required one should enter 0 here. Population distribution by sex and five-year age groups is always included in the output.

```
Reading the data from the file.

Reading the title from the file
The title is
Edmonton

Reading the base year from the file
Base year is 1990
  ====== PRESS ENTER ======
```

Here the base data required for population projection (initial age distribution, age-specific fertility rate, survival rate, etc.) are being read from the input file. The programme shows the identifying lines on the screen and pauses after reading each item. The lines echoed on the screen will be useful to locate error in the input data file.

```
Reading the last age in the age distribution
The last age in the age distribution is  90
  ====== PRESS ENTER ======
```

```
Reading the distribution of males
Age distribution of males

Read  13 numbers; 78 more needed
Read  26 numbers; 65 more needed
Read  39 numbers; 52 more needed
Read  52 numbers; 39 more needed
Read  65 numbers; 26 more needed
Read  78 numbers; 13 more needed
  ====== PRESS ENTER ======
```

The message in the above screen show that the age distribution of males was read from seven lines, each of which contained 13 numbers. If there is a message showing that characters other than numbers were encountered in the input file, it indicates that the data file didn't contain enough data in this section.

```
Reading the distribution of females
Age distribution of females

Read  13 numbers; 78 more needed
Read  26 numbers; 65 more needed
Read  39 numbers; 52 more needed
Read  52 numbers; 39 more needed
Read  65 numbers; 26 more needed
Read  78 numbers; 13 more needed
  ====== PRESS ENTER ======
```

The following four screen images show the messages after reading successfully the age distribution of in- and out-migrants by sex.

```
Reading the distribution of male in-migrants
Age distribution of in-migrants: Males

Read  17 numbers; 74 more needed
Read  33 numbers; 58 more needed
Read  53 numbers; 38 more needed
Read  83 numbers;  8 more needed
   ====== PRESS ENTER ======
```

```
Reading the distribution of female in-migrants
Age distribution of in-migrants: Females

Read  20 numbers; 71 more needed
Read  38 numbers; 53 more needed
Read  61 numbers; 30 more needed
   ====== PRESS ENTER ======
```

```
Reading the distribution of male out-migrants
Age distribution of out-migrants: Males

Read  17 numbers; 74 more needed
Read  33 numbers; 58 more needed
Read  52 numbers; 39 more needed
Read  82 numbers;  9 more needed
   ====== PRESS ENTER ======
```

```
Reading the distribution of female out-migrants
Age distribution of out-migrants: Females

Read  18 numbers; 73 more needed
Read  34 numbers; 57 more needed
Read  53 numbers; 38 more needed
Read  83 numbers;  8 more needed
   ====== PRESS ENTER ======
```

The following box shows the reading of age-specific fertility rates. The programme always reads 38 numbers representing the fertility rates from age 12 to 49.

```
Reading fertility rates of  females aged 12 to 49
Age specific fertility rates for ages 12 - 49

Read  10 numbers; 28 more needed
Read  20 numbers; 18 more needed
Read  30 numbers;  8 more needed
   ====== PRESS ENTER ======
```

The survival rates are being read in the following two screen images. Since the last age was given as 90, the programme will require 91 survival rates.

```
Reading the male survival rates
Survival rates for males
Read   9 numbers; 82 more needed
Read  18 numbers; 73 more needed
Read  27 numbers; 64 more needed
Read  36 numbers; 55 more needed
Read  45 numbers; 46 more needed
Read  54 numbers; 37 more needed
Read  63 numbers; 28 more needed
Read  73 numbers; 18 more needed
Read  83 numbers;  8 more needed
   ======= PRESS ENTER =======
```

```
Reading the female survival rates
Survival rates for females

Read   9 numbers; 82 more needed
Read  18 numbers; 73 more needed
Read  27 numbers; 64 more needed
Read  36 numbers; 55 more needed
Read  45 numbers; 46 more needed
Read  54 numbers; 37 more needed
Read  63 numbers; 28 more needed
Read  73 numbers; 18 more needed
Read  83 numbers;  8 more needed
   ======= PRESS ENTER =======
```

All the required data have been successfully read and they will be written on the output device (file or printer) and the user should check to see that they are correct.

In the following section the user is prompted to give the number of special custom made age groups desired in the output. If none is required one may enter 0 (zero) as the response.

```
Write the NUMBER of special age groups
(in addition to the 5 - year age groups)
for which you wish to have the population
distribution printed out
2
Now   2 special age group(s) will
be created
```

Here two special age groups are requested. The maximum number of special age groups that can be requested is ten.

```
Write the lower and upper limit of each of
the age groups: one line for each age group
and two numbers (lower and upper limit of the age group) on each
line.

The lower and upper limit of the  1th special group
6  16
The lower and upper limit of the  2th special group
15  49
```

The limits of the age groups are given here. The first special age group is ages 6 to 16 and the second age group is 15 to 49.

```
Write the number of in-migrants per year
First the number of males and then the number of females:
800 750

Write the number of out-migrants per year
First the number of males and then the number of females:
100   100
```

Here the user is prompted to give the number of in- and out migrants per year. It is permissible to give any or all of them as zeros.

```
The current year is   1990
For how many years initially do you wish to
project the population without changing any
of the parameters?
5
```

Now the population will be projected for five years without any change in the current survival rates, birth rates by age, and the annual number of migrants.

```
The current year is   1995
Type   1 to continue or  0 to stop
1
```

The programme has completed the projection for five years and results are saved on the output device specified. If the response given in the above screen was zero the programme would have stopped at this point.

```
Now the fertility and migration estimates can be changed.
You may also change the survival rates (mortality) provided the
male and female survival rates are stored in the file attached to unit
8 (i. e. the input file).
```

```
FIRST,
The number of male and female in-migrants
ENTER the two numbers:
0  0
NOW,
The number of male and female out-migrants
Enter the two numbers:
0  0
```

The new values of in- and out migration are given as zero here. If the migration level is to be kept at the same level as before, the same numbers entered before should be repeated here.

```
NOW, TOTAL FERTILITY:
   At present TFR is    1.9187
   What is the new fertility rate?
1.85
```

The new total fertility rate is given as 1.85. The fertility level can be kept unchanged by giving the TFR as 1.9187 instead of 1.85.

```
NOW, MORTALITY:
Do you wish to change the survival rates
(mortality) of males and females?
   Type 0 for no change or
   1 to read a new set from the
   file attached to unit 8
1
```

To change the mortality one enters "1" here. Then the programme will try to read a new set of survival rates from the input file. If the input file does not contain a new set of survival rates the programme will stop abnormally with an error message.

```
Reading female survival rates
Survival rates for Males: second set
Read   9 numbers; 82 more needed
Read  18 numbers; 73 more needed
Read  27 numbers; 64 more needed
Read  36 numbers; 55 more needed
Read  45 numbers; 46 more needed
Read  54 numbers; 37 more needed
Read  63 numbers; 28 more needed
Read  73 numbers; 18 more needed
Read  83 numbers;  8 more needed
   ====== PRESS ENTER ======
```

```
Reading female survival rates
Survival rates for females: second set

Read  9 numbers; 82 more needed
Read  18 numbers; 73 more needed
Read  27 numbers; 64 more needed
Read  36 numbers; 55 more needed
Read  45 numbers; 46 more needed
Read  54 numbers; 37 more needed
Read  63 numbers; 28 more needed
Read  73 numbers; 18 more needed
Read  83 numbers;  8 more needed
  ====== PRESS ENTER ======
```

The new survival rates are copied to the output file also so that one can verify its accuracy. At this point the new set of parameters of population change have been read by the programme and it is ready to make the projection for any number of years.

```
For how many years do you wish to apply the new parameters
without any change?
5
```

The population projection will be carried forward for years and the results will be saved on the output file or printer.

```
The current year is  2000
Type  1 to continue or  0 to stop
0
The projection terminated at year 2000
  ====== PRESS ENTER ======
```

Calculation of Survival Rates

During each projection cycle, the population that is alive at the beginning of the year will be subject to mortality and the adjustment for mortality is made by applying survival rates by age and sex. The survival rates are derived from a life table that represents the mortality conditions which are assumed to prevail during the projection year.

The programme LIFTAB is designed to construct life table and survival rates by single years of age. The input for this programme is death rates by five year age groups (except for the age group below five). The output includes an abridged life table and survival rates. Age specific death rates for ages 0, 1 to 4, 5 to 9, .. etc., are required here in this programme. The data should be stored in a file and should have the following items.

1. Last age (which will be an open interval) for which age specific death rate is available.

2. A descriptive line identifying the area, year, and sex for which the life table is being

calculated.

3. The age specific death rates of age groups 0, 1 to 4, 5 to 9, ... till the age specified in item one is reached.

One may enter more than one set of death rates by repeating items 2 and 3 in the file. An example of such an input data is given below. This data is saved in the file DRATE2.DAT.

```
85
Males Alberta
.0199 .0009 .0006 .0005 .0014 .0018 .0015 .0016 .0022 .0036
.0057 .0093 .0146 .0229 .0347 .0519 .0790 .1188 .1986
Females Alberta
.0151 .0008 .0004 .0003 .0006 .0006 .0006 .0009 .0013 .0021
.0030 .0046 .0072 .0110 .0173 .0283 .0481 .0824 .1633
```

Projection of Survival Rate for a Specified Expectation of Life at Birth

In this section a simple method of estimating the survival rates based on past trends and a computer to programme to make the required calculations are described. The programme SURPROJ reads four sets of age specific death rates (two sets for males and two sets for females). These rates should be for two periods of time. The observed rate of change in "person years lived" (L_x) is applied to estimate the survival rate for any given expectation of life at birth. The input data for this programme should be in a file and should contain the following items.

1. Last age (which will be an open interval) for which age specific death rate is available.

2. A descriptive line identifying the male death rate for period one.

3. The age specific death rates of males by age groups 0, 1 to 4, 5 to 9, ... till the age specified in item one is reached.

4. A descriptive line identifying the female death rate for period one

5. The age specific death rates of females by age groups 0, 1 to 4, 5 to 9, ... till the age specified in item one is reached.

6. A descriptive line identifying the male death rate for period two.

7. The age specific death rates of males by age groups 0, 1 to 4, 5 to 9, ... till the age specified in item one is reached.

8. A descriptive line identifying the female death rate for period two

9. The age specific death rates of females by age groups 0, 1 to 4, 5 to 9, ... till the age specified in item one is reached.

An example of such an input data is given below. These data are saved in the file DRATE4.DAT.

```
90
Males Alberta set 1
.0199 .0009 .0006 .0005 .0014 .0018 .0015 .0016 .0022 .0036
.0057 .0093 .0146 .0229 .0347 .0519 .0790 .1188 .1986 .21
Females Alberta set 1
.0151 .0008 .0004 .0003 .0006 .0006 .0006 .0009 .0013 .0021
.0030 .0046 .0072 .0110 .0173 .0283 .0481 .0824 .1633 .19
Males Alberta set 2
.0089 .000486 .000298 .00030 .00107 .001362 .001234 .001248
.001569 .002405 .003982 .006916 .011401 .018787 .02914
.04473  .06930 .104076 .184076 .22
Females Alberta set 2
.007243 .000432 .000209 .000201 .000351 .000409 .000444
.000579 .000847 .001445 .002242 .003712 .005965 .009139 .014669 .022981
.038390 .063937 .138687 .21
```

The Programme calculates the expectations of life at birth for both periods by sex and displays them on the screen. The user can give any expectation of life at birth for males and females and the corresponding survival rates will be calculated and stored in the output file. The output file will also contain the survival rates from the life table corresponding to the second set of age specific death rates.

A Sample Output from PROJS

The following is the output produced by PROJS using EDM2.DAT as the input file.

Edmonton
5-Year Age-Groups, 1990

Age	Total	Male	Female
0 - 4	46155.	23614.	22541.
5 - 9	40510.	20928.	19582.
10 - 14	33936.	17177.	16759.
15 - 19	38527.	19066.	19461.
20 - 24	58043.	28078.	29965.
25 - 29	67321.	33500.	33821.
30 - 34	61264.	31223.	30041.
35 - 39	47431.	24217.	23214.
40 - 44	37188.	18655.	18533.
45 - 49	28962.	14267.	14695.
50 - 54	25678.	12736.	12942.
55 - 59	24704.	12355.	12349.
60 - 64	22133.	10546.	11587.
65 - 69	18773.	8481.	10292.
70 - 74	12968.	5520.	7448.
75 - 79	9560.	3776.	5784.
80 - 84	6063.	2288.	3775.
85+	4656.	1528.	3128.
Total	583872.	287955.	295917.
Median Age	30.56	30.24	30.89

Population in special age groups

Age	Total	Male	Female
6 - 16	78707.	40170.	38537.
15 - 49	338736.	169006.	169730.

Edmonton
5-Year Age-Groups, 1991

Age	Total	Male	Female
0 - 4	47604.	24397.	23207.
5 - 9	42049.	21603.	20446.
10 - 14	35123.	17907.	17216.
15 - 19	35082.	17600.	17482.
20 - 24	55225.	26534.	28692.
25 - 29	66944.	33075.	33869.
30 - 34	63348.	32209.	31139.
35 - 39	50083.	25503.	24579.
40 - 44	39637.	20068.	19569.
45 - 49	29762.	14667.	15095.
50 - 54	26175.	12967.	13208.
55 - 59	24540.	12161.	12379.
60 - 64	22634.	10918.	11716.
65 - 69	19215.	8713.	10503.
70 - 74	13464.	5750.	7714.
75 - 79	9858.	3886.	5971.
80 - 84	6246.	2323.	3923.
85+	4820.	1591.	3229.
Total	591808.	291870.	299938.
Median Age	31.02	30.69	31.36

Population in special age groups

Age	Total	Male	Female
6 - 16	81081.	41477.	39605.
15 - 49	340081.	169656.	170425.

Annual Population change summary

	Males	Females	Total
In-Migrants	800.	750.	1550.
Out-Migrants	100.	100.	200.
Net-Migrants	700.	650.	1350.
Births	5288.	5081.	10369.
Deaths	2073.	1710.	3783.
Nat. Increase	3215.	3371.	6586.
Pop. Increase	3915.	4021.	7936.

Crude Birth Rate: .018
General Fertility Rate: .059
Crude Death Rate: .006
Total Fertility Rate 1.919

New Survival Rates

Age	Males	Females

0	.99509	.99592
1	.99780	.99805
2	.99945	.99960
3	.99950	.99963
4	.99956	.99966
5	.99994	.99970
6	.99969	.99974
7	.99976	.99978
8	.99983	.99982
9	.99987	.99985
10	.99988	.99987
11	.99983	.99987
12	.99972	.99984
13	.99957	.99980
14	.99944	.99976
15	.99939	.99975
16	.99933	.99975
17	.99916	.99972
18	.99895	.99969
19	.99879	.99966
20	.99870	.99964
21	.99869	.99963
22	.99869	.99962
23	.99873	.99963
24	.99877	.99962
25	.99874	.99961
26	.99871	.99959
27	.99876	.99958
28	.99882	.99958
29	.99887	.99957
30	.99885	.99954
31	.99882	.99951
32	.99882	.99949
33	.99882	.99948
34	.99880	.99945
35	.99873	.99940
36	.99864	.99933
37	.99858	.99926
38	.99851	.99918
39	.99841	.99909
40	.99824	.99898
41	.99805	.99886
42	.99790	.99876
43	.99774	.99865
44	.99753	.99852
45	.99721	.99834
46	.99685	.99814
47	.99649	.99797
48	.99609	.99779
49	.99564	.99757
50	.99509	.99729
51	.99449	.99698
52	.99389	.99664
53	.99324	.99627

54	.99251	.99588
55	.99167	.99542
56	.99072	.99497
57	.98966	.99456
58	.98849	.99414
59	.98724	.99363
60	.98600	.99299
61	.98462	.99227
62	.98299	.99153
63	.98119	.99073
64	.97931	.98985
65	.97749	.98883
66	.97553	.98774
67	.97324	.98665
68	.97071	.98549
69	.96804	.98417
70	.96559	.98267
71	.96276	.98093
72	.95901	.97894
73	.95465	.97671
74	.95023	.97431
75	.94627	.97168
76	.94225	.96893
77	.93729	.96604
78	.93177	.96289
79	.92586	.95920
80	.91960	.95479
81	.91288	.94953
82	.90554	.94332
83	.89732	.93601
84	.88787	.92737
85	.87680	.91704
86	.86354	.90443
87	.84726	.88865
88	.82669	.86826
89	.79965	.84080
90	.79546	.80750

Edmonton
5-Year Age-Groups, 1992

Age	Total	Male	Female
0 - 4	48917.	24975.	23942.
5 - 9	43603.	22463.	21141.
10 - 14	36253.	18524.	17729.
15 - 19	33169.	16817.	16352.
20 - 24	52490.	25177.	27314.
25 - 29	65213.	32122.	33091.
30 - 34	65361.	33042.	32319.
35 - 39	53084.	27093.	25991.
40 - 44	41767.	21211.	20556.
45 - 49	30749.	15125.	15623.

50 - 54	26580.	13110.	13470.
55 - 59	24399.	12063.	12336.
60 - 64	23171.	11280.	11891.
65 - 69	19518.	8863.	10655.
70 - 74	14189.	6061.	8129.
75 - 79	10068.	3992.	6076.
80 - 84	6452.	2359.	4094.
85+	4957.	1613.	3344.
Total	599940.	295890.	304051.
Median Age	31.48	31.15	31.82

Population in special age groups

Age	Total	Male	Female
6 - 16	83808.	42845.	40963.
15 - 49	341833.	170587.	171245.

Annual Population change summary

	Males	Females	Total
In-Migrants	800.	750.	1550.
Out-Migrants	100.	100.	200.
Net-Migrants	700.	650.	1350.
Births	5370.	5160.	10530.
Deaths	2050.	1697.	3748.
Nat. Increase	3320.	3463.	6783.
Pop. Increase	4020.	4113.	8133.

Crude Birth Rate: .018
General Fertility Rate: .059
Crude Death Rate: .006
Total Fertility Rate 1.919

Sample Output from LIFTAB.

The following life tables and survival rates were produced by running the programme LIFTAB and using the file DRATE2.DAT as the input data file.

Males Alberta set 1

Age	Mx	qx	lx	dx	Lx	Tx	Ex
0	.01990	.01859	100000.	1859.	98654.	6960878.	69.61
1 - 4	.00090	.00352	98141.	345.	391667.	6862223.	69.92
5 - 9	.00060	.00300	97796.	293.	488164.	6470556.	66.16
10-14	.00050	.00250	97503.	243.	486986.	5982392.	61.36
15-19	.00140	.00698	97259.	679.	484730.	5495406.	56.50
20-24	.00180	.00896	96581.	866.	480747.	5010676.	51.88
25-29	.00150	.00747	95715.	715.	476765.	4529929.	47.33
30-34	.00160	.00797	95000.	757.	473172.	4053164.	42.66
35-39	.00220	.01094	94243.	1031.	468823.	3579993.	37.99
40-44	.00360	.01785	93211.	1664.	462217.	3111170.	33.38
45-49	.00570	.02813	91547.	2575.	451795.	2648952.	28.94
50-54	.00930	.04552	88972.	4050.	435448.	2197158.	24.69
55-59	.01460	.07060	84922.	5995.	410565.	1761710.	20.74
60-64	.02290	.10866	78927.	8576.	374295.	1351144.	17.12
65-69	.03470	.16029	70351.	11277.	324615.	976849.	13.89
70-74	.05190	.23064	59074.	13625.	262089.	652235.	11.04
75-79	.07900	.33051	45449.	15022.	189743.	390146.	8.58

```
 80-84        .11880   .45562  30428.  13864. 116998.   200403.    6.59
  85 +        .19860  1.00000  16564.  16564.  83405.    83405.    5.04
 Males Alberta set 1                                          eo= 69.61
  .986541  .994293  .998730  .998856  .998984  .999989  .999253  .999386
  .999511  .999605  .999645  .999611  .999494  .999318  .999156  .999120
  .999053  .998815  .998524  .998302  .998191  .998189  .998216  .998297
  .998360  .998319  .998288  .998380  .998507  .998688  .998560  .998487
  .998457  .998413  .998337  .998216  .998061  .997893  .997700  .997478
  .997208  .996921  .996634  .996328  .995972  .995532  .995047  .994562
  .994041  .993456  .992777  .992032  .991250  .990406  .989482  .988488
  .987381  .986139  .984775  .983330  .981916  .980342  .978445  .976332
  .974154  .972104  .969917  .967284  .964371  .961325  .958536  .955397
  .951306  .946587  .941743  .936983  .932261  .927409  .922165  .916191
  .909206  .900858  .890685  .878057  .861976  .824964
 Females Alberta set 1
0  Age          Mx       qx       lx      dx      Lx       Tx       Ex
   0          .01510   .01418 100000.   1418.   98974.  7678250.   76.78
 1 - 4        .00080   .00313  98582.    308.  393520.  7579276.   76.88
 5 - 9        .00040   .00200  98274.    196.  490823.  7185757.   73.12
 10-14        .00030   .00150  98078.    147.  490041.  6694934.   68.26
 15-19        .00060   .00300  97931.    293.  488950.  6204893.   63.36
 20-24        .00060   .00300  97637.    293.  487454.  5715944.   58.54
 25-29        .00060   .00300  97345.    292.  486024.  5228489.   53.71
 30-34        .00090   .00449  97053.    436.  484245.  4742465.   48.86
 35-39        .00130   .00648  96617.    626.  481639.  4258219.   44.07
 40-44        .00210   .01045  95991.   1003.  477612.  3776580.   39.34
 45-49        .00300   .01490  94988.   1415.  471637.  3298968.   34.73
 50-54        .00460   .02276  93573.   2130.  462921.  2827331.   30.22
 55-59        .00720   .03541  91443.   3238.  449664.  2364410.   25.86
 60-64        .01100   .05363  88205.   4730.  429973.  1914746.   21.71
 65-69        .01730   .08314  83475.   6940.  401155.  1484773.   17.79
 70-74        .02830   .13264  76535.  10152.  358832.  1083618.   14.16
 75-79        .04810   .21558  66383.  14311.  297736.   724786.   10.92
 80-84        .08240   .34216  52072.  17817.  217280.   427050.    8.20
  85 +        .16330  1.00000  34255.  34255.  209770.   209770.    6.12
 Females Alberta set 1                                        eo= 76.78
  .989736  .995336  .999055  .999129  .999213  .999311  .999409  .999516
  .999623  .999713  .999767  .999771  .999717  .999624  .999549  .999543
  .999546  .999490  .999422  .999371  .999332  .999332  .999368  .999427
  .999465  .999449  .999409  .999389  .999364  .999330  .999281  .999226
  .999170  .999108  .999034  .998946  .998844  .998732  .998608  .998477
  .998331  .998184  .998039  .997888  .997719  .997493  .997268  .997088
  .996911  .996684  .996368  .995998  .995627  .995222  .994776  .994263
  .993723  .993187  .992621  .991980  .991180  .990332  .989531  .988690
  .987705  .986476  .985095  .983679  .982130  .980377  .978526  .976299
  .973533  .970335  .966975  .963532  .959936  .956046  .951673  .946591
  .940593  .933417  .924722  .914037  .900651  .853737
```

Sample Output from SURPROJ

The programme SURPROJ and the data file DRATE4.DAT were used to produce the following survival rates. The first set of survival rates printed here corresponds to the second set of age specific death rates in the data file.

The second set of survival rates were calculated by the programme adjusting the expectation of life at birth for males and females to 73.5 and 80.1 respectively.

```
Males Alberta set 2                                   Males eo= 72.96
  .993911  .997324  .999350  .999414  .999481  .999950  .999633  .999711
  .999784  .999836  .999847  .999801  .999692  .999539  .999399  .999355
  .999293  .999111  .998892  .998724  .998633  .998620  .998628  .998675
  .998711  .998680  .998653  .998706  .998781  .998830  .998812  .998773
  .998770  .998763  .998734  .998657  .998565  .998489  .998405  .998289
  .998102  .997901  .997732  .997554  .997321  .996990  .996607  .996232
  .995821  .995351  .994781  .994162  .993539  .992870  .992112  .991256
  .990282  .989200  .988007  .986736  .985470  .984068  .982408  .980570
  .978659  .976808  .974826  .972493  .969922  .967213  .964725  .961857
  .958073  .953688  .949223  .945220  .941144  .936107  .930499  .924499
  .918146  .911351  .903941  .895663  .886170  .875067  .861801  .845566
  .825126  .798389  .796209
Females Alberta set 2                                 Female eo= 79.61
  .995036  .997662  .999521  .999557  .999597  .999643  .999690  .999741
  .999791  .999833  .999857  .999855  .999823  .999772  .999729  .999720
  .999717  .999685  .999648  .999618  .999595  .999587  .999588  .999597
  .999600  .999583  .999561  .999555  .999550  .999538  .999504  .999468
  .999447  .999427  .999393  .999333  .999258  .999183  .999098  .999003
  .998887  .998768  .998658  .998545  .998409  .998219  .998019  .997844
  .997663  .997444  .997166  .996842  .996500  .996125  .995724  .995261
  .994797  .994366  .993926  .993406  .992743  .991999  .991255  .990452
  .989557  .988507  .987383  .986249  .985037  .983657  .982111  .980305
  .978221  .975868  .973350  .970673  .967833  .964717  .961284  .957350
  .952772  .947431  .941187  .933855  .925174  .914734  .901924  .885802
  .864839  .836407  .809317
Males Alberta set 2                                     Males eo= 73.50
  .995086  .997803  .999448  .999501  .999560  .999944  .999692  .999762
  .999827  .999872  .999879  .999831  .999723  .999574  .999437  .999392
  .999331  .999157  .998950  .998790  .998702  .998687  .998693  .998734
  .998766  .998736  .998710  .998757  .998824  .998868  .998852  .998818
  .998818  .998818  .998796  .998726  .998644  .998582  .998514  .998415
  .998241  .998052  .997902  .997744  .997529  .997214  .996847  .996488
  .996094  .995640  .995087  .994487  .993887  .993244  .992510  .991673
  .990717  .989658  .988488  .987242  .985996  .984617  .982989  .981189
  .979313  .977488  .975531  .973237  .970710  .968044  .965594  .962759
  .959007  .954653  .950226  .946267  .942247  .937285  .931769  .925862
  .919597  .912879  .905536  .897315  .887869  .876798  .863537  .847261
  .826690  .799651  .795460
Females Alberta set 2                                 Female eo= 80.10
  .995915  .998046  .999598  .999627  .999660  .999698  .999736  .999778
  .999819  .999853  .999871  .999868  .999840  .999796  .999759  .999749
  .999745  .999717  .999685  .999658  .999638  .999628  .999624  .999625
  .999622  .999605  .999586  .999582  .999581  .999572  .999540  .999508
  .999493  .999479  .999451  .999396  .999325  .999256  .999178  .999089
  .998977  .998863  .998759  .998652  .998521  .998337  .998140  .997966
  .997785  .997566  .997294  .996978  .996640  .996271  .995876  .995421
  .994970  .994555  .994135  .993633  .992992  .992265  .991529  .990731
  .989850  .988828  .987743  .986653  .985492  .984169  .982670  .980928
```

```
.978943  .976711  .974313  .971684  .968931  .966035  .962888  .959200
.954785  .949529  .943319  .936006  .927374  .917040  .904430  .888652
.868261  .840802  .807502
```

Steps Involved in Population Projection Using PROJS

1. Get the data for the initial year.

2. Calculate survival rates using LIFETAB or SURPROJ programme.

3. Create a data file similar to EDM1.DAT or EDM2.DAT using any file editor or word processing programme. Notice that if there is only one set of survival rates the mortality level cannot be changed. In EDM2.DAT there are two sets of survival rates and so the mortality level can be changed once.

4. Run the programme PROJS and use the option to see all the steps in reading data from the data file. Watch for any message which may indicate errors in input data file. When the base data are printed back by the programme they should be checked for correctness.

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